

## GENETIC VARIABILITY, CORRELATION AND PATH COEFFICIENT ANALYSIS IN CHICKPEA (*Cicer arietinum* L.) FOR YIELD AND ITS COMPONENT TRAITS

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### ABSTRACT

*The present study was aimed to study the extent of genetic variability for yield and yield component traits, nature of association among different characters and path coefficient examinations of 13 yield attributing traits in 23 chickpea genotypes. which were sown. The higher value of the phenotypic co-potential (PCV) of the variant than the corresponding genetic coefficient (GCV) for all the traits studied indicated that there was an influence of the environment. The number of seeds per plant was recorded with high estimates of GCV and PCV. Higher estimates of heredity were observed, along with higher genetic progression per plant, number of secondary branches, number of seeds per plant, seed yield per plant, organic yield per plant and seed index, which yields improved by direct selection. Characters that rely on isotonic expression by a simple selection method are more reliable. Correlation between grain yield per plant, number of nuts per plant, number of seeds per plant, number of seeds per plant, 50% flowering days, days to maturity, crop index and number of primary branches per plant, both genetically and positively. The phenomenon levels that indicate the selection of these traits may be beneficial to improve yields. The path coefficient analysis showed that the organic yield per crop, the crop index, the number of primary branches per plant and the number of secondary branches per plant have positive direct effects on the grain yield per plant. The present study indicated that above mentioned traits should given to further genetic improvement of chickpea because they posses high genetic variance, high heritability coupled with genetic correlation among themselves which are maybe due to high yield with high genetic advance in a breeding programme.*

**KEYWORDS:** Chickpea, genetic variability, heritability, correlation, path coefficient analysis

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### INTRODUCTION

Chickpea (*Cicer arietinum* L.) is a self - pollinated diploid with  $2n=2x=16$ . Chickpea is the third most important cool season food legume crop of the world. It is a vital source of protein and vitamins for millions of people. As the legume is harvested, it biologically fixes the nitrogen in the soil and increases soil fertility. *Desi* and *Kabuli* are two distinct groups within the cultivated species of chickpea and about 85% of the total chickpea production in the world is of *Desi* type. *Kabuli* type though much in demand is not much grown here because of its poor yield and relatively higher water requirement. In general these types tend to be semi- erect, but lower yielding under Indian soil conditions than *Desi* types. Genetic variation between traits is important for reproduction and selection of desirable varieties on the other hand is a parameter of particular importance to the inheritance of the metric character because it is the level of similarity between parents and offspring. And its size refers to the inheritance in which a genetic form can be identified by its

phenotypic expression. However genetic predisposition can help achieve the desired selection stress. The Character Association provides information about each other in the desired direction and the roles associated with seed yield. Therefore, these correlations help a lot in the selection to improve the added benefit and yield which are divided into direct and indirect effects through route analysis. The aim of this study was to assess overall genetic variation, correlation, and pathogenesis among some important traits for selection criteria to improve chickpea yields under normal conditions.

## MATERIALS AND METHODS

The experimental materials comprising of 23 genotypes include one check were grown under randomized block design (RBD) with three replications at Field Experimentation Centre of Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj, U.P. during Rabi 2020. Observations for different quantitative traits were recorded on five randomly selected competitive plants for each treatment in each replication, were days to 50% flowering, days to 50% pod setting, Plant height, number of primary branches per plant, number of secondary branches per plant, days to maturity, number of pods per plant, number of seeds per pod, number of seeds per plant, biological yield per plant, harvest index, 100-seed weight and seed yield per plant. Data were subjected to statistical analysis to work out genotypic (GCV) and phenotypic (PCV) coefficients of variation, heritability, genetic advance and genetic advance as percent of mean as per their standard methods. Standard statistical procedure used for ANOVA, genotypic and phenotypic coefficient of variation (Burton, 1952), heritability broad sense (Hanson *et al.*, 1956) and genetic advance (Johnson *et al.*, 1955). The genotypic and phenotypic correlation coefficients were computed by using genotypic and phenotypic variances and co-variances (Al Jibouri *et al.*, 1958). The path coefficient analysis was done according to the method by (Dewey and Lu 1959).

## RESULTS AND DISCUSSION

Analysis of variance showing there is significant difference among the genotypes for fifteen characters (Table 1) used under the study at 5% and 1% level of significant. This indicates that there is sufficient scope for selection of genotypes for yield and its components. Estimates of genetic variation parameters for yield and its component characteristics are presented in Table 2. The genetic coefficient of variation measures the magnitude of the genetic variation present in the crop and reflects the genetic component of the variation. It is therefore considered more useful than the isotropic coefficient of diversity. Furthermore, the difference between the phenotypic and genetic coefficients of diversity refers to the operation of environmental factors. (Dhanwani *et al.*, 2013). The magnitude of PCV was higher than GCV for all the characters which may due to higher degree of interaction of genotype with the environment (Senapati and Kumar, 2015). Moderate genotypic coefficient of variation was observed for number of seeds per pod and harvest index. Phenotypic coefficient of variation was high for number of seeds per plant followed by biological yield per plant, number of pods per plant, seed yield per plant, secondary branches per plant, seed index and number of primary branches per plant. Higher GCV and PCV was observed in and indicated that, these test hybrids exhibited much variation among themselves with respect to these characters shows more scope of selection. Similar results were reported by Vange and Moses (2009) and Babbar *et al.*, (2012). Days to Maturity showed the highest heritability among all the characters followed by number of secondary branches per plant, number of seeds per plant, days to 50% flowering, seed yield per plant, biological yield per plant, seed index. Mushtaq et al reported similar results. (2013) and Puri et al. (2013)

showed high inheritance values for seed number per pod, seed yield per plant, organic yield per plant, seed index and number of secondary branches per plant. In the present study, high estimates were observed such as number of secondary branches per plant, number of seeds per plant, seed yield per plant, organic yield per plant, high heredity and high genetic progression to seed index. Respectively, the additive genetic function that controls the inheritance of this character dominates and provides the best potential for improvement through simple selection. Therefore, the selection of these properties increases gram production and productivity. Similar results were reported by Kuldeep *et al.* (2014) and Kumar *et al.* (2017).

Correlation studies in breeding material can help in developing a selection scheme that will help increase the genetic potential of the crop. It provides reliable information on range and nature selection, especially when needed to combine high yield potential with desirable characteristics and seed quality characters. Information on genetic correlation is more consistent and is very important for a plant to bring about genetic development by selecting the roles of genetically correlated couples. At the genetic level, seed yield per plant is the number of nuts per plant, organic yield per plant, number of seeds per plant, 50% pod setting, number of seeds per pod, days to 50% flowering days. By maturity, the number of secondary branches per plant, crop index and number of primary branches per plant (Table 3). At the typical level, the grain yield per plant is expressed positively with the number of nuts per plant, organic yield per plant, number of seeds per plant, days of maturity, 50% flowering days, crop index and number of primary branches per plant. Showed an important relationship. Table 4). Similar results have been reported in the past by Kuldeep *et al.* (2014) on the number of secondary branches per plant, Shafiq *et al.*, (2016) on seed yield.

The path coefficient analysis divides the correlation coefficient into a measure of direct and indirect effect, i.e., direct and indirect contributions of different independent characters on the dependent character. A perusal of the results on path coefficient for yield and yield components genotypic to be of similar direction and magnitude in general. Further the genotypic path co-efficient were observed to be of higher magnitude, compared to phenotypic path coefficient indicating the masking effect of environment. Path analysis of diagonal values showed positive direct effect of biological yield per plant, harvest index, number of primary branches per plant, days to 50% pod setting, number of secondary branches per plant, days to maturity and plant height. Similar results were reported earlier by Mohan *et al.* (2019) on number of secondary branches per plant, Agarwal *et al.* (2018) on harvest index, days to 50% pod setting and plant height (Table 5 & figure 1).

**Table 1: Analysis of variance (ANOVA) for 13 quantitative traits in 23 chickpea genotypes**

	Characters	Mean Sum of Squares		
		Replications	Treatments	Error
		(df = 2)	(df = 22)	(df = 44)
	<b>Days to 50 % Flowering</b>	1.49	32.98**	2.14
	<b>Days to 50 % Pod setting</b>	0.54	93.18**	3.42
	<b>Plant Height</b>	1.85	9.71**	0.74
	<b>Number of Primary branches per Plant</b>	15.08	69.66*	31.22
	<b>Number of Secondary branches per Plant</b>	0.41	0.38**	0.16
	<b>Days to Maturity</b>	230.71	266.45	231.74
	<b>Number of Pods per Plant</b>	215.71	1669.12**	119.97
	<b>Number of Seeds per Pod</b>	0.03	0.23**	0.07
	<b>Number of Seeds per Plant</b>	60.3	2716.83**	211.39
	<b>Biological Yield per Plant</b>	54.66	311.89**	57.2

	<b>Harvest Index</b>	675.79	828.73**	117.37
	<b>100 Seed weight</b>	185.21	96.45**	71.64
	<b>Grain Yield per Plant</b>	25.86	131.21**	13.59

\*\* significant at 1% level of significance,

\* significant at 5% level of significance

**Table 2: Genetic parameters for thirteen quantitative characters in twenty three chickpea genotypes**

Characters	GCV	PCV	h <sup>2</sup> (bs)(%)	GA	GA as % mean
Days to 50 % Flowering	3.894	4.279	82.834	6.137	7.301
Days to 50 % Pod setting	3.798	12.537	9.177	2.711	2.37
Plant Height	6.232	11.189	31.02	4.251	7.15
Number of Primary branches per Plant	23.937	32.636	53.795	0.559	36.167
Number of Secondary branches per Plant	29.687	32.377	84.078	3.319	56.076
Days to Maturity	3.009	3.143	91.652	8.289	5.933
Number of Pods per Plant	39.531	53.004	55.624	28.921	60.734
Number of Seeds per Pod	16.292	28.207	33.359	0.231	19.384
Number of Seeds per Plant	54.199	59.476	83.041	55.243	101.743
Biological Yield per Plant	39.171	46.714	70.312	28.201	67.662
Harvest Index	11.245	21.417	27.568	5.024	12.163
100 Seed weight	26.481	34.069	60.418	13.777	42.402
Grain Yield per Plant	38.636	44.391	75.752	11.61	69.272

h<sup>2</sup>= Heritability, GCV= Genotypic Variation, PCV= Phenotypic Variation,  
GA= Genetic advance, GA as% mean= Genetic advance as percent mean

**Table 3: Genotypic correlation for thirteen characters in chickpea**

Characters	DF50%	DPS50%	PH	NPBP	NSBP	DM	NPPP	NSPPOD	NSPP	BYPP	HI	SI	SYPP
DF50%	1	1.100**	0.338**	0.477**	0.122	0.716**	0.490**	0.037	0.231	0.510**	0.538**	0.207	0.393**
DPS50%		1	0.669**	0.489**	-0.014	1.058**	0.631**	0.359**	0.442**	0.767**	0.970**	0.631**	0.701**
PH			1	0.336**	-0.098	0.161	0.131	0.466**	0.246*	0.089	0.471**	0.032	0.196
NPBP				1	-0.069	0.476**	-0.179	0.135	-0.023	-0.192	-0.001	0.675**	0.150**
NSBP					1	0.262*	0.057	-0.535**	0.013	-0.187	-0.275*	-0.300*	0.172**
DM						1	0.488**	0.019	0.422**	0.437**	0.454**	0.201	0.373**
NPPP							1	0.134	0.959**	1.052**	-0.192	-0.313*	1.030**
NSPPOD								1	0.383**	0.503**	0.369**	-0.091	0.523**
NSPP									1	0.895**	-0.076	0.321**	0.913**
BYPP										1	-0.179	-0.143	1.010**
HI											1	0.067	0.004*
SI												1	-0.094
SYPP													1

DF50%= days to 50 % flowering, DPS50%= days to 50 % pod setting, PH= plant height, NPBP= number of primary branches per plant  
NSBP= number of secondary branches per plant, DM= days to maturity, NPPP= number of pods per plant, NSPOD= number of seeds per  
pod, NSPP= number of seeds per plant, BYPP= biological yield per plant, HI= harvest index, SI=100 seed weight and SYPP= seed yield per  
plant.

\*\* indicates 5% level of significance respectively

\* indicates 1% level of significance respectively

Table 4: Phenotypic correlation for thirteen characters in chickpea

Characters	DF50%	DPS50%	PH	NPBP	NSBP	DM	NPPP	NSPPOD	NSPP	BY	HI	SI	SYPP
DF50%	1	0.327**	0.608**	-0.396**	0.055 <sup>NS</sup>	0.608**	0.302*	0.011 <sup>NS</sup>	0.139 <sup>NS</sup>	0.352**	-0.259*	0.135 <sup>NS</sup>	0.275*
DPS50%		1	0.120 <sup>NS</sup>	-0.207 <sup>NS</sup>	0.041 <sup>NS</sup>	0.308*	0.115 <sup>NS</sup>	0.069 <sup>NS</sup>	0.118 <sup>NS</sup>	0.279*	-0.406**	0.118 <sup>NS</sup>	0.172 <sup>NS</sup>
PH			1	0.121 <sup>NS</sup>	-0.053 <sup>NS</sup>	0.128 <sup>NS</sup>	0.163 <sup>NS</sup>	0.093 <sup>NS</sup>	0.195 <sup>NS</sup>	0.185 <sup>NS</sup>	-0.115 <sup>NS</sup>	0.006 <sup>NS</sup>	0.182*
NPBP				1	-0.001 <sup>NS</sup>	-0.382**	-0.159 <sup>NS</sup>	0.141 <sup>NS</sup>	-0.026 <sup>NS</sup>	0.068 <sup>NS</sup>	-0.070 <sup>NS</sup>	-0.256*	-0.046 <sup>NS</sup>
NSBP					1	0.226 <sup>NS</sup>	0.092 <sup>NS</sup>	-0.249*	0.056 <sup>NS</sup>	0.076 <sup>NS</sup>	-0.136 <sup>NS</sup>	-0.142 <sup>NS</sup>	-0.087 <sup>NS</sup>
DM						1	0.341**	-0.050 <sup>NS</sup>	0.356**	0.371**	-0.255*	0.166 <sup>NS</sup>	0.311*
NPPP							1	0.096 <sup>NS</sup>	0.763**	0.737**	-0.036 <sup>NS</sup>	-0.254*	0.764**
NSPPOD								1	0.127 <sup>NS</sup>	0.108 <sup>NS</sup>	0.156 <sup>NS</sup>	0.192 <sup>NS</sup>	0.196 <sup>NS</sup>
NSPP									1	0.830**	-0.002 <sup>NS</sup>	-0.288*	0.880**
BY										1	-0.167 <sup>NS</sup>	-0.072 <sup>NS</sup>	0.912**
HI											1	0.035 <sup>NS</sup>	0.011**
SI												1	-0.114 <sup>NS</sup>
SYPP													1

DF50%= days to 50 % flowering, DPS50%= days to 50 % pod setting, PH= plant height, NPBP= number of primary branches per plant  
NSBP= number of secondary branches per plant, DM= days to maturity, NPPP= number of pods per plant, NSPOD= number of seeds per  
pod, NSPP= number of seeds per plant, BYPP= biological yield per plant, HI= harvest index, SI=100 seed weight and SYPP= seed yield per  
plant.

\*\* indicates 5% level of significance respectively

\* indicates 1% level of significance respectively

Table 5: Direct and indirect effects of component traits on seed yield per plant in  
chickpea for yield and its component traits at genotypic level

Characters	DF50%	DPS50%	PH	NPBP	NSBP	DM	NPPP	NSPPOD	NSPP	BYPP	HI	SI
DF50%	-0.3615	-0.2951	-0.1049	-0.0372	-0.0403	-0.3865	-0.052	0.1303	-0.0068	-0.1353	0.2978	-0.04
DPS50%	0.4521	0.554	0.2604	0.0288	0.1446	0.218	0.1368	-0.2294	0.0615	0.1624	-0.3786	0.0728
PH	0.0035	0.0057	0.0121	0.0088	-0.0008	-0.0189	0.0027	0.0032	0.0026	0.0006	-0.0019	-0.001
NPBP	0.0627	0.0317	0.4441	0.6103	0.0305	-0.5573	-0.0128	0.0141	0.0235	-0.0227	-0.6197	-0.3886
NSBP	0.0045	0.0106	-0.0028	0.002	0.0405	-0.0016	0.0012	-0.0192	-0.0016	-0.0097	-0.0139	-0.0158
DM	0.031	0.0114	-0.0453	-0.0264	-0.0011	0.029	0.0126	0.0027	0.0136	0.0217	-0.003	-0.0054
NPPP	-0.1605	-0.2756	-0.2481	0.0235	-0.0317	-0.4855	-1.1158	-0.2922	-1.0917	-1.0523	0.0579	0.6097
NSPPOD	0.1806	0.2075	-0.1349	-0.0116	0.2375	-0.0466	-0.1313	-0.5012	-0.2008	-0.2138	-0.1935	0.1802
NSPP	-0.0008	-0.0047	-0.0091	-0.0016	0.0016	-0.02	-0.0416	-0.017	-0.0425	-0.0379	-0.0038	0.0233
BYPP	0.7661	0.6002	0.1049	-0.0762	-0.49	1.5371	1.9306	0.8732	1.8229	2.0473	0.2555	-0.6738
HI	-0.7066	-0.5861	-0.1383	-0.871	-0.294	-0.0875	-0.0445	0.3312	0.0759	0.107	0.8578	0.4225
SI	-0.0501	-0.0596	0.0394	0.2886	0.1767	0.0837	0.2477	0.163	0.2483	0.1492	-0.2233	-0.4533
SYPP	0.2209	0.2	0.1774	-0.0621	-0.2265	0.2641	0.9335	0.4587	0.9048	1.0167	0.0315	-0.2693

DF50%= days to 50 % flowering, DPS50%= days to 50 % pod setting, PH= plant height, NPBP= number of primary branches per plant  
NSBP= number of secondary branches per plant, DM= days to maturity, NPPP= number of pods per plant, NSPOD= number of seeds per  
pod, NSPP= number of seeds per plant, BYPP= biological yield per plant, HI= harvest index, SI=100 seed weight and SYPP= seed yield per  
plant.

RESIDUAL EFFECT = 0.2930



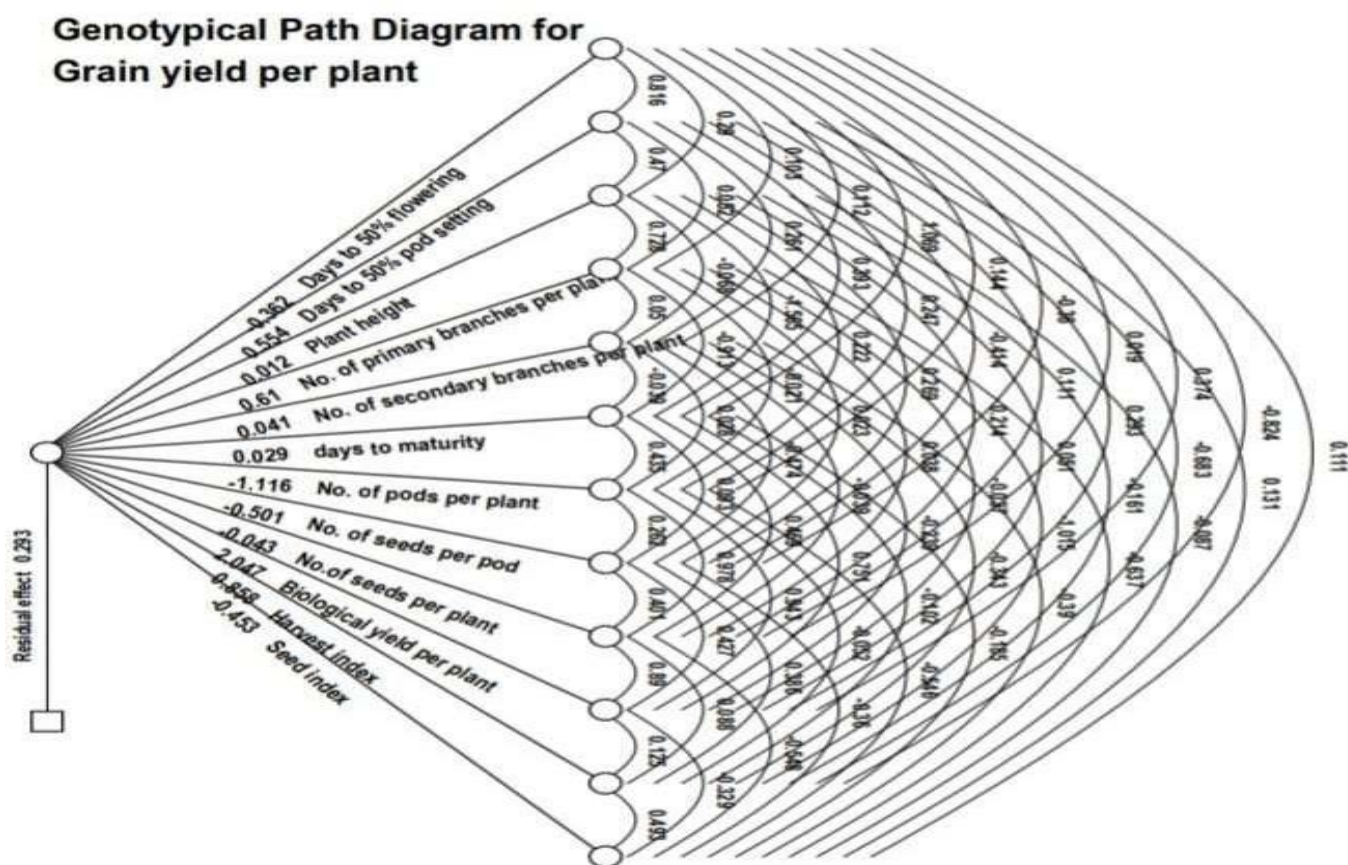


Figure 1: Genotypic path diagram for yield and its component traits on seed yield per plant

## CONCLUSIONS

The present study concluded that the characters high estimates of heritability coupled with high genetic advance as present of mean was observed for number of secondary branches per plant, number of seeds per plant, seed yield per plant, biological yield per plant and seed index. Respectively suggesting that there was preponderance of additive gene action governing the inheritance of this character and offers the best possibility of improvement through simple selection. Hence selection of these characters can bring enhancement in chickpea production and productivity.

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